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Christian Janze
Goethe University Frankfurt, janze@wiwi.uni-frankfurt.de

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Christian Janze, Faculty of Economics and Business Administration, Goethe University Frankfurt, Frankfurt, Hesse, Germany, janze@wiwi.uni-frankfurt.de

Abstract

User-generated online reviews are an important decision aid for consumers affecting purchase probabilities and sales figures. However, little is known about factors influencing the review generation process. Thus, this paper empirically examines the impact of cross-organizational spillover effects on user-generated online service reviews. Specifically, we study how the overall perception of consumers towards a service provider expressed in online reviews is affected by upstream service providers in interdependent service chains (ISCs). Based on the Treatment-By-Association (TBA) phenomenon, we design a research model to study both the existence and evolvement of cross-organizational spillover effects in online reviews of ISCs. Utilizing every airline and airport review posted over 13 years on www.AirlineQuality.com, we show that both positive and negative spillover effects exist: Increased (decreased) overall ratings of an upstream service node are associated with increased (decreased) ratings of the directly following service node in the ISC. In addition, we show that this is not true for more distantly arranged service nodes. We contribute to the IS research stream of online reviews by shedding light on spillover effects and by providing evidence for the proposed TBA. Furthermore, suggestions how practitioners could manage and utilize spillover effects to improve their customer experience are provided.

Keywords: Spillover Effects, User-generated Content, Interdependent Service Chains, Linear Mixed-Effects.

1 INTRODUCTION

The importance of user-generated content in general and online reviews in particular becomes clear when considering findings that indicate a relationship between user-generated online reviews and purchase likelihood (East et al. 2008; Sparks, et al. 2013) as well as sales figures (Chevalier & Mayzlin 2006; Forman et al. 2008). Information Systems (IS) researchers acknowledge the importance of online reviews. However, while many papers address the topic of perceived helpfulness (Mudambi & Schuff 2010; Korfiatis et al. 2012; Siering & Muntermann 2013; Yin et al. 2014), little is known about drivers of the actual review generation process. The latter question is addressed only recently by IS scholars (Goes et al. 2014; Janze & Siering 2015; Wang et al. 2015).

In our study, we attempt to fill this research gap by addressing cross-organizational spillover effects as one additional driver of the online review generation process. We define the spillover effect closely to Janakiraman et al. (2009) as the extent to which "existing information and perceptions influence beliefs that are not directly addressed by or related to the original information source or perception object". While marketing (Ahluwalia et al. 2001; Erdem & Sun 2002; Balachander & Ghose 2003), IS (Wang et al. 2015) and finance (Fan et al. 2008; Zhang et al. 2008; Brown et al. 2015) literature provide some insights into spillover effects, cross-organizational spillover effects in user-generated online reviews are not thoroughly addressed yet.

We draw on recent findings of Wang et al. (2015) that showed in a different context how spillover effects in firms' crisis events negatively affect cross-organizational supply chain partnerships. The authors find that crisis-struck firms' adverse price movements reflected by abnormal returns, news volume and word of mouth (WOM) volume have both a direct and mediating effect on abnormal returns of their supply chain partner firms. Based on remarks of Wang et al. (2015), we address several important topics: First, the necessity to examine spillover effects in stronger supply chain partnerships. We address this in our study by utilizing a setting that exhibits a very strong supply chain partnership, namely interdependent service chains. We define an interdependent service chain as a service that consists of more than one service node, which are typically not used or usable without one-another but often operated by various providers. In our empirical study, we assess spillover effects in the interdependent service chain "one-way non-stop flight" consisting of three service nodes (airport of departure, airline and airport of arrival) that are operated by different companies. Second, the authors suggest examining international data to enhance the generalizability of the study results. We address this by examining a sample of airline and airport reviews of a very international origin. Third, the authors propose the usage of a more comparable set of events to draw conclusions from. We focus on one specific and very comparable event: A flight with associated online reviews of the respective airlines and airports used. This also helps to reduce the possibility of confounding events and most importantly allows us to study both positive and negative spillover effects. For example, when an individual had a very nice and relaxing flight, he might perceive and thus rate the airport of arrival better and likewise perceive and rate the airport of departure poorly if he had a very bad flight experience. In addition, we are interested in how and to what extent spillover effects evolve over multiple nodes of an interdependent service chain. This is both an important and not thoroughly addressed topic. In summary, our study tackles the following two research questions (RQs):

- *RQ1: Do spillover effects exist in user-generated online reviews of interdependent service chains?*
- *RQ2: How do spillover effects in user-generated online reviews evolve over multiple nodes of an interdependent service chain?*

We specify numerous linear mixed-effect models to study both direct and indirect spillover effects in user-generated online reviews of interdependent service chains. Our results show that both positive and negative spillover effects exist: Increased (decreased) ratings of service nodes are associated with increased (decreased) ratings of directly following service nodes in user-generated online reviews of interdependent service chains. In addition, we find no evidence for spillover effects in user-generated online reviews of more distantly arranged service nodes. Thus, we show that spillover effects are an

important driver of the online review generation process. Furthermore, we provide suggestions how practitioners could manage and utilize our findings regarding spillover effects to improve their customer experience.

The remaining portion of this paper is structured as follows: Section two provides additional background on user-generated online reviews. Furthermore, we give a brief overview of findings regarding spillover effects provided in multiple disciplines (IS, marketing and finance). Additionally, we draw on various psychological effects to propose a TBA effect. Based on the TBA, we design a research model consisting of four research hypotheses. Section three specifies our research methodology by explaining our sample selection and data acquisition procedures, the variable operationalization as well as the design of our linear mixed effect models and moderation analysis. In section four, we present the results of our empirical study and evaluate our research model. The section closes with a discussion of the results. Section five concludes the study.

2 BACKGROUND AND RESEARCH MODEL

2.1 User-Generated Online Reviews

The interaction and communication of users is a key element of social commerce platforms that can be defined as venues where "people can collaborate online, get advice from trusted individuals, find goods and services, and then purchase them" (Liang & Turban 2011). In these online communities, "consumers share their experiences, opinions and knowledge with other consumers" (Gheorghe & Liao 2012) by means of online reviews.

Numerous studies of IS scholars are concerned with online reviews. For example Mudambi and Schuff (2010) show that the depth and extremity of online reviews determine their perceived helpfulness. Their findings are complemented by research that finds additional determinants of the perceived helpfulness, such as readability (Korfiatis et al. 2012), writing style (Siering & Muntermann 2013) and emotions (Wu et al. 2011; Yin et al. 2014). Goes et al. (2014) provide evidence for a popularity effect in user-follow-user settings in online communities that influences the writing style of user-generated online reviews. Janze and Siering (2015) generalize this concept to a status effect that is also present in online communities without the explicit possibility to follow other users.

Apart from these studies, little is known about underlying drivers of the actual review generation processes and even less about cross-organizational spillover effects in user-generated online reviews of interdependent service chains.

2.2 Spillover Effect

Spillover refers the extent to which "existing information and perceptions influence beliefs that are not directly addressed by or related to the original information source or perception object" (Janakiraman et al. 2009). As summarized by Wang et al. (2015), spillover effects have been examined in "different associations in a variety of contexts, such as between attributes, between products, and between brands": Regarding brands, Balachander and Ghose (2003) show the existence of reciprocal spillover effects in line and brand extensions strategies by utilizing scanner panel data of two product categories available in two regional markets. Comparable insights are provided by Erdem and Sun (2002). The authors empirically show "advertising and sales promotion spillover effects for frequently purchased packaged products".

In a case study of a co-branded sports team, Kahuni et al. (2009) show "some evidence of bad image transfer" in crisis events. Ahluwalia et al. (2001) show how negative information spills over to attributes of an unknown brand. However, they found no evidence for the same mechanism in case of positive information. In addition, they show how consumer commitment can mitigate these adverse spillover effects. Spillover effects have been observed across competing products, but only for sufficiently similar products (Janakiraman et al. 2009). Roehm and Tybout (2006) provide experimental evidence for similar mechanisms and show under which conditions spillover effects "negatively affect attitudes

and beliefs about product category and about competing brands". Further evidence for negative spillover effects between product categories and competing brands is provided by Dahlén (2006) and Yu et al. (2008). Rutz and Bucklin (2011) show that spillover in paid search advertising is asymmetric, meaning that "generic search activity positively affects branded search activity via increased awareness but branded search does not affect generic search". Carmi et al. (2010) show spillover effects across online and offline media by co-purchase data from the social commerce platform Amazon.com.

While spillover effects have been observed in numerous fields of study such as marketing (Ahluwalia et al. 2001; Erdem & Sun 2002; Balachander & Ghose 2003), IS (Wang et al. 2015) and finance (Fan et al. 2008; Zhang et al. 2008; Brown et al. 2015), research regarding cross-organizational spillover effects is still sparse and primarily limited to negative spillover effects in firms' crisis events (Wang et al. 2015). Thus and to the best of our knowledge, no previous work on spillover effects in interdependent service chains exist.

2.3 Treatment-By-Association (TBA)

It is an interesting question what kind of underlying psychological phenomenon is the reason for spillover effects in UGC in general and interdependent service chains in particular. Essentially this means that an entity such as a firm is punished or rewarded for the association with another entity. The American Heritace New Dictionary of Cultural Literacy (2005) defines Guilt-By-Association (GBA) as "the attribution of guilt to individuals because of the people or organizations with which they associate, rather than because of any crime that they have committed". GBA was used in numerous related studies. For example, Kahuni et al. (2009) show bad image spillover effects in a co-branding setting of a sports team that is attributed to GBA. Wang et al. (2015) use GBA as a theoretical foundation to study spillover effects in crisis situations.

However, as GBA only covers negative consequences of the association of individuals with people or organizations, we propose the Treatment-By-Association (TBA) effect that we define very closely to GBA: TBA is the attribution of positive and negative characteristics to entities because of the entities they associate with and includes an implicit memory component. TBA is therefore related to the psychological concept of priming that was found in multiple experiments conducted by Meyer and Schvaneveldt (1971), Schvaneveldt and Meyer (1973), and Meyer et al. (1975). "Priming is the process by which perception (or experience) of an item (or person or event) leads to an increase in its accessibility and the accessibility of related material and behaviours" (Baumeister & Vohs 2007). For example, when someone experienced a very pleasant flight, his accessibility to positive feelings and emotions will be increased when using the airport of arrival. We will test for the proposed TBA effect later on in this paper.

2.4 Research Model

Our research model presented in Figure 1 covers both RQ1 ("Do spillover effects exist in user-generated online reviews of interdependent service chains?") and RQ2 ("How do spillover effects in user-generated online reviews evolve over multiple nodes of an interdependent service chain). Our research model consists of an interdependent service chain of three service nodes that are subsequently used. We define a service node as a sub-service within an interdependent service chain.

To assess the first research question (RQ1) whether spillover effects exist in online reviews of interdependent service chains, we formulate two hypotheses, H1a and H1b. In this case, we focus on direct spillover effects from one service node to the directly following service node in interdependent service chains.

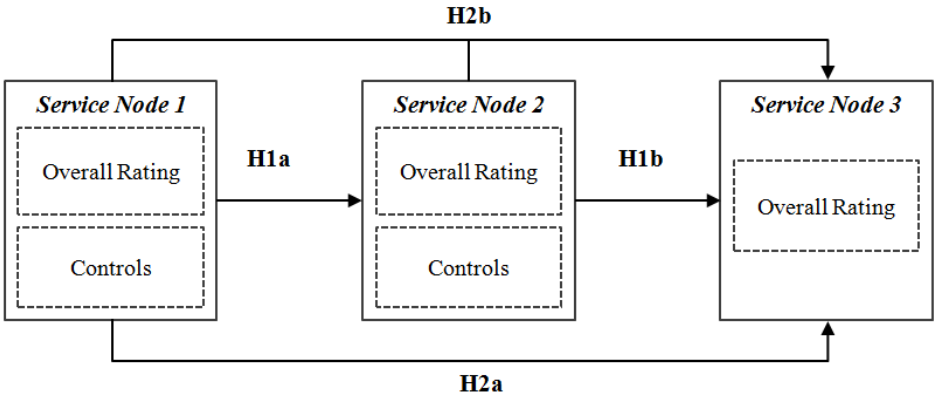


Figure 1. Research model to examine the existence (RQ1) and evolvement (RQ2) of spillover effects in interdependent service chains

Based on our generalized version of the psychological GBA effect, the TBA effect, we hypothesize that overall positive and negative ratings of the upstream service node spill over to the overall perception of the following service node. Therefore, two direct spillover effects are possible. First, from service node one to service node two and second from service node two to service node three. While research hypothesis H1a covers the first possibility, H1b is concerned with the second possibility:

- H1a: Increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 2
- H1b: Increased (decreased) overall ratings of service node 2 are associated with increased (decreased) overall ratings of service node 3

In our second research question (RQ2), we are interested in assessing the question of how spillover effects in user-generated content evolve over multiple nodes of an interdependent service chain. Our interdependent service chain presented in Figure 1 exists of three service nodes that are subsequently used by consumers of the service chain. Based on the assumption of an implicit memory effect in the definition of the TBA effect introduced in the previous section, there are two ways spillover effects could evolve from service node 1 to service node 3. First, it could be direct from service node 1 to service node 3. Second, it could be moderated by service node 2. To account for the first possibility of a direct effect, we formulate the research hypothesis H2a:

- H2a: Increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3

To account for the possibility of a moderating effect of service node 2 on the evolvement of spillover effects from service node 1 to service node 3, we formulate the research hypothesis H2b. Specifically, we cover the possibility of an interaction between the consumer perception of the two upstream service nodes 1 and 2 within the interdependent service chain impacting user-generated online reviews of service node 3.

- H2b: Increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3. However, the effect is moderated by the overall ratings of service node 2.

In the operationalization of our research model, we will control for numerous variables such as the socio-economic status of interdependent service chain users, temporal shifts in the rating behaviour that has been observed by Janze and Siering (2015) as well as subject specific differences in the rating behaviour (i.e. the tendency of some individuals to provide overly positive or negative ratings).

3 RESEARCH METHODOLOGY

In this section, we describe our approach to operationalize our research model. As previously mentioned, this paper is interested in examining whether spillover effects exist in reviews of interdependent service chains and if so, how they evolve over multiple nodes of a service chain. In the following, we will describe our rationales for the sample selection. Subsequently, we describe our data acquisition procedures and variable operationalization decisions. Finally, we present the design of our regression and moderator analysis.

3.1 Data Set Acquisition

Flights are a great example of an interdependent service chain as they typically consist of multiple service nodes that are operated by different providers. In our case, we assess the three service nodes airport of departure, airline and airport of arrival of non-stop one way flights.

The data used in this study was retrieved on August 2nd, 2015 from the online review site www.airlinequality.com and made available by Quang (2015). The online review site is operated by the UK based consultancy firm Skytrax (formerly known as Inflight Research Services). Skytrax refers to itself as the "leading air travel review site" (Skytrax 2015b). Insight provided by Skytrax is often cited by magazines, newspapers etc.: A Google News search of the term "Skytrax" on October 10th, 2015 yields a number of 25,400 articles mentioning Skytrax. As of August, 2nd 2015, Skytrax allows users to post reviews in the following four categories: Airlines, airports, lounges and seats (Skytrax 2015a). We retrieved all reviews from the former two categories yielding a total of 41,396 airline and 17,721 airport reviews. Example airline and airport reviews are shown in Figure 2.

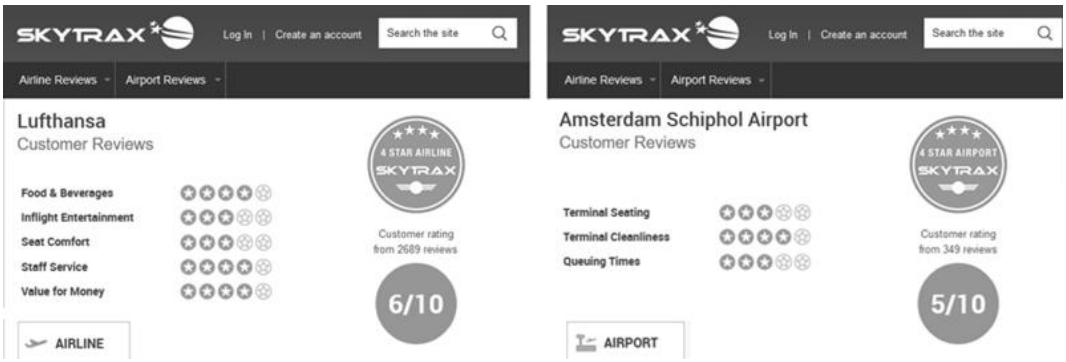


Figure 2. Example Airline (left) and Airport Review (right) on Skytrax

To merge the user-generated online reviews within the airline and airport data sets, we used the reviewer name, reviewer country and review date variables as an identifier within R (version 3.2.4). We did so to include only airline reviews with at least one associated airport review (either departure or arrival). As our model represents a directional service chain, we excluded all flights other than one-way and non-stop flights (i.e. flights with multiple legs etc). We performed a missing completely at random (MCAR) test proposed by Jamshidian and Jalal (2010) on partially incomplete numerical overall ratings of the airports and airlines (variables are described in more detail later in this paper). The test suggest that the assumption of MCAR cannot be rejected at the 5% significance level. Therefore biases are ruled out and imputation techniques appear applicable: We used the full data samples (41,396 airline- and 17,724 airport reviews) to conduct grouped mean imputations by each airport and airline overall rating separately. Our final data set of 283 observations consists of three different groups of observations: First, a total of 249 observations in which both the airline- and airport of departure overall numerical rating could be observed. Second, a total 255 reviews in which both the airline and airport of arrival were observed. Third, a total of 237 observations which include all three nodes of the one-way non-stop flights, namely reviews of the airline, the airport of departure and the airport of arrival.

3.2 Variable Operationalization

Table 1 presents the variable operationalization of the interdependent service chain "flight" we use as our study subject. As a direct result of our focus on non-stop one way flights, our interdependent service chain naturally consists of three service nodes: we collect numerical ratings of the airport of departure (ap1_rating), the airport of arrival (ap2_rating) as well as the airline (al_rating). Each of these ratings ranges from 1 (worst) to 10 (best).

It is likely that different airlines and airports as well as airlines and airports itself exhibit different review characteristics (e.g. seat space of airlines vs. queuing times at airports) and overall quality levels (e.g. cheap airlines vs. premium airlines) leading to different review behaviour of reviewers. Therefore, we z-standardize the ap1_rating, ap2_rating and al_rating variables. In specific, we take into account a reviewers numerical overall rating of a specific airline or airport relative to all other reviewers overall rating of the same airport or airline in the full data sample (41,396 airline- and 17,724 airport reviews). The z-standardization presented in Equation 1 works as follows: For each numerical overall airport or airline review denoted as x we subtract the mean overall numerical rating μ of all reviews concerning the same airport or airline. We then divide the resulting number by the standard deviation σ of all reviews of the same airport or airline to yield the z-standardized version of the respective variables (ap1_rating_z, ap2_rating_z and al_rating_z).

$$z = \frac{x - \mu}{\sigma} \tag{1}$$

Thus, the transformed z-standardized variables (ap1_rating_z, ap2_rating_z and al_rating_z) represent the unsigned number of standard deviations the observed overall rating variables (ap1_rating, ap2_rating and al_rating) deviate from the mean overall numerical rating expressed towards a specific airport or airline.

Short Name	**Full Name**	**Description**
ap1_rating_z	Z-Score of Airport of Departure Rating	Z-standardized version of the overall rating of the airport of departure.
ap2_rating_z	Z-Score of Airport of Arrival Rating	Z-standardized version of the overall rating of the airport of arrival.
al_rating_z	Z-Score of Airline Rating	Z-standardized version of the overall rating of the airline.
days_pass	Days Passed	Age of the interdependent service chain review: Days passed until the data acquisition date on August 2nd, 2015.
price_lvl	Price Level	Recoded version of the cabin a reviewer used: Economy=1, Premium Economy=2, Business Class=3, First Class=4.
auth	Author	Unique identifier of the author of a review.

Table 1. Variables of an Interdependent Service Chain Review on Skytrax

To control for time effects, we calculate the days passed since the respective review was written and the data collection on August 2nd, 2015 (days_pass). Furthermore, to control for varying expectations because of price differences of different flight classes, we recode the cabin flown by a passenger as an additional control variable (price_lvl). Furthermore, we use the unique identifier of the author of a review (auth) as a random intercept in our mixed effect models to rule out subject specific differences in the rating behaviour (i.e. the potential tendency of some reviewers to generate overly positive or negative reviews).

3.3 Linear Mixed Effect Models and Interaction Analysis

We operationalize our research model by several linear mixed effect models and moderator analysis techniques. First, we show our approach in operationalizing the two research hypotheses H1a and H1b surrounding our first research question RQ1, which is concerned with the question whether spillover effects exists in online reviews of interdependent service chains. Second, we show the operationalization of our second set of research hypotheses H2a and H2b that aim to shed light on the second research question RQ2 of how spillover effects in user-generated content evolve over multiple nodes of an interdependent service chain.

Our first research hypothesis (H1a) states that increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 2 in interdependent service chains. We operationalize this in Equation 2 by defining the airport of departure (ap1_rating_z) as the independent service node 1 and the airline (al_rating_z) as the dependent service node 2. In addition, we include the price level of the flight (price_lvl) as well as the days passed since the review was written (days_pass) as independent control variables as discussed earlier. Furthermore and to account for differences in the rating behaviour between subjects, we include the identifier of the review author (auth) as a random intercept term to the mixed effect model:

$$al\_rating\_z_i = \alpha + \beta_1 ap1\_rating\_z_{\_i} + \beta_2 price\_lvl_i + \beta_2 days\_pass_i + (auth_i + \varepsilon) \quad (2)$$

Our second research hypothesis (H1b) states that increased (decreased) overall ratings of the service node 2 are associated with increased (decreased) overall ratings service node 3. Our linear mixed-effects specification to operationalize this hypothesis is presented in Equation 3. Here, we use the z-standardized overall rating of the airline (al_rating_z) as the independent variable representing service node 2 and the z-standardized overall rating of the airport of arrival (ap2_rating_z) as the dependent variable representing service node 3. Furthermore, we include the controls price_lvl and days_pass as well as the random intercept term auth:

$$ap2\_rating\_z_i = \alpha + \beta_1 al\_rating\_z_i + \beta_2 price\_lvl_i + \beta_3 days\_pass_i + (auth_i + \varepsilon) \quad (3)$$

Our third research hypothesis (H2a) states that increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3. We use the z-standardized overall rating of the airport of departure (ap1_rating_z) as the independent variable representing service node 1 and the z-standardized overall rating of the airport of arrival (ap2_rating_z) as the dependent variable representing service node 3 in our linear mixed effects setup presented in Equation 4. Again, we include the controls price_lvl and days_pass as well as the random intercept term auth:

$$ap2\_rating\_z_i = \alpha + \beta_1 ap1\_rating\_z_i + \beta_2 price\_lvl_i + \beta_3 days\_pass_i + (auth_i + \varepsilon) \quad (4)$$

Our fourth research hypothesis (H2b) posits that increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3 but that this effect is moderated by the overall ratings of service node 2. As described by Edwards and Lambert (2007), "moderation occurs when the effect of an independent variable on a dependent variable varies according to the level of a third variable, termed a moderator variable, which interacts with the independent variable". The moderator effect is described extensively by James and Brett (1984) and Baron and Kenny (1986) and summarized by Aiken and West (1991). We use the z-standardized overall rating of the airport of departure (ap1_ratinz_z) as a proxy for service node 1 and the z-standardized overall rating of the airport of arrival (ap2_rating_z) as a proxy for service node 3. Service node 2 is represented by the z-standardized overall rating of the airline (al_rating_z). As we aim to examine the potentially moderating effect of service node 2, we not only add both the z-standardized ap1_rating_z

and al_rating_z as independent variables in our regression setup but also an interaction term of these two variables. This interaction term is calculated by multiplying ap1_rating_z and al_rating_z variables and adding them as a fixed effects term to the mixed effects model. This is a well known approach in tackling the question whether "the prediction of a dependent variable, Y, from an independent variable, X, differs across levels of a third variable, Z" (Fairchild & MacKinnon 2009). Furthermore, we add the controls price_lvl and days_pass as well as the random intercept term auth.Equation 5 summarizes the reasoning above:

$$ap2\_rating\_z_i = \alpha + \beta_1 ap1\_rating\_z_i + \beta_2 al\_rating\_z_i + \beta_3 (ap1\_rating\_z_i * al\_rating\_z_i) + \beta_4 price\_lvl_i + \beta_5 days\_pass_i + (auth_i + \varepsilon) \quad (5)$$

4 EMPIRICAL STUDY

In the following, we will first present descriptive statistics of our data sample and evaluate our research model using various regression setups and moderator analysis techniques described in the previous section. Subsequently, we evaluate our research model by providing empirical results.

4.1 Descriptive Statistics

Summary statistics of the interdependent service chain reviews in our sample are presented in Table 2. The mean (median) z-standardized overall rating for the airport of departure (ap1_rating_z), airport of arrival (ap2_rating_z) and the airline (al_rating_z) is 0.31 (0.24), 0.29 (0.26) and 0.26 (0.37) respectively. The standard deviations range between 0.77 (al_rating_z) and 0.89 (ap1_rating_z) and are therefore comparable. Looking at the days passed since the review was written (days_pass), the mean (median) yields 628.02 (493) days. Furthermore, recalling that we recoded the cabin a reviewer flew in as a proxy for the price level of a specific flight (price_lvl) so that economy=1, premium economy=2, business class=3, first class=4, it becomes clear that most reviewers flew in the economy class as the variable yields a mean (median) of 1.43 (1).

Variable	n	Mean	Median	Min.	Max.	Range	Std. Error	Std. Dev.
ap1_rating_z	264	0.31	0.24	-1.52	2.48	4.00	0.05	0.89
ap2_rating_z	269	0.29	0.26	-2.17	3.90	6.06	0.06	0.99
al_rating_z	283	0.26	0.37	-1.86	1.99	3.86	0.05	0.77
days_pass	275	628.02	493	1	3,043	3,042	36.38	603.33
price_lvl	267	1.43	1	1	4	3	0.05	0.85

Table 2. Summary statistics of interdependent service chain reviews

Pearson product-moment correlation coefficients of the variables used in our study are presented in Table 3. It can be noted that the correlations among the variables are relatively low with a maximum of .2703 between the ap2_rating_z and the al_rating_z variable.

Variable	ap1_rating_z	ap2_rating_z	al_rating_z	days_pass	price_lvl
ap1_rating_z	1				
ap2_rating_z	0.0638	1			
al_rating_z	0.1583	0.2703	1		
days_pass	-0.2177	-0.2118	-0.0542	1	
price_lvl	-0.0598	0.0444	0.1497	-0.1642	1

Table 3. Variable correlations

4.2 Evaluation of the Research Model

In this section, we evaluate our proposed research model by fitting our four linear mixed-effect models to the data sample. We calculate the results via maximum likelihood estimation using R (version 3.2.4) and the lme4 package (version 1.1-11). T-values and p-values are calculated using the package lmerTest (version 2.0-30) and Satterthwaite's or Kenward-Roger's approximations. Table 4 presents our results, which we discuss in the following.

In our first research question RQ1, we are interested in the question whether spillover effects exist in online reviews of interdependent service chains. To assess this question, we state two research hypothesis H1a and H1b regarding our three node interdependent service chain. We can confirm spillover effects in user-generated online reviews from both the first service node to the second (see model 1 in Table 4) and the second service node to the third (see model 2 in Table 4).

Model	Fixed effects						Random effects			Model statistics	
	Variable	Coeff.	Std. Error	t-Value	p-Value	VIF	Variable	σ^2	Std. Dev.	Cond. (Mar.) R^2	N
1 (H1a)	(Intercept)	-0.050	0.122	-0.411	0.681		auth	0.236	0.485	0.454 (0.059)	249
	ap1_rating_z	0.164	0.053	3.106	0.002***	1.045	residual	0.325	0.570		
	Controls: Yes										
2 (H1b)	(Intercept)	0.462	0.142	3.247	0.001***		auth	0.000	0.000	0.093 (0.093)	255
	al_rating_z	0.324	0.077	4.197	0.000***	1.023	residual	0.876	0.936		
	Controls: Yes										
3 (H2a)	(Intercept)	0.431	0.160	2.699	0.008***		auth	0.000	0.000	0.032 (0.032)	237
	ap1_rating_z	0.030	0.074	0.406	0.685	1.044	residual	0.948	0.974		
	Controls: Yes										
4 (H2b)	(Intercept)	0.457	0.155	2.950	0.004***		auth	0.000	0.000	0.098 (0.098)	237
	ap1_rating_z	-0.010	0.076	-0.132	0.895	1.181	residual	0.884	0.940		
	al_rating_z	0.348	0.084	4.137	0.000***	1.131					
	ap1_rating_z * al_rating_z	-0.072	0.086	-0.833	0.406	1.222					
	Controls: Yes										

* p<10%, ** p<5%, *** p<1%. Controls: price_lvl and days_pass variables.

Table 4. Results of Linear Mixed Effect Models

More specifically, in model 1, that is concerned with H1a, we see a statistically significant positive effect of the z-standardized overall rating of the airport of departure (ap1_rating_z) variable on the z-standardized overall rating of the airline (al_rating_z) used. The coefficient (coeff) of the ap1_rating_z variable of 0.164 indicates that for an increase (decrease) of 1 standard deviation of the z-standardized overall rating of the airport of departure rating, the z-standardized overall rating of the airline increases (decreases) by 0.164 standard deviations. The effect is statistically significant on the 1% significance level. The conditional (cond.) and marginal (mar.) R^2 of 0.454 and 0.059 indicates that our research model explains 45.4% (and 5.9% respectively) of the variance. The marginal R^2 is based on the fixed effects only while the conditional R^2 is based on fixed and random effects. A variance inflation factor (VIF) of 1.045 shows that our mixed effects model is not subject to multicollinearity issues. Thus, we accept H1a that "increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 2".

Regarding model 2, that examines H1b, we see again a statistically significant spillover effect from the z-standardized overall rating of the airline used (al_rating_z) on the z-standardized overall rating of the airport of arrival (ap2_rating_z). Here, the coefficient of al_rating_z variable yields 0.324 and is statically significant on the 1% level. Thus, an increase (decrease) of al_rating_z of 1 standard deviations increases (decreases) the ap2_rating_z by 0.324 standard deviations. The model yields an conditional (marginal) R^2 of 0.093 (0.093) and thus explains 9.3% of the overall variance. The VIF score of 1.023 again provides no evidence for potential multicollinerity problems. We therefore accept H1b that posits that an "increased (decreased) overall ratings of service node 2 are associated with increased (decreased) overall ratings service node 2".

Therefore, the answer to our first research question RQ1 whether cross-organizational spillover effects exist in online reviews of interdependent service chains is yes.

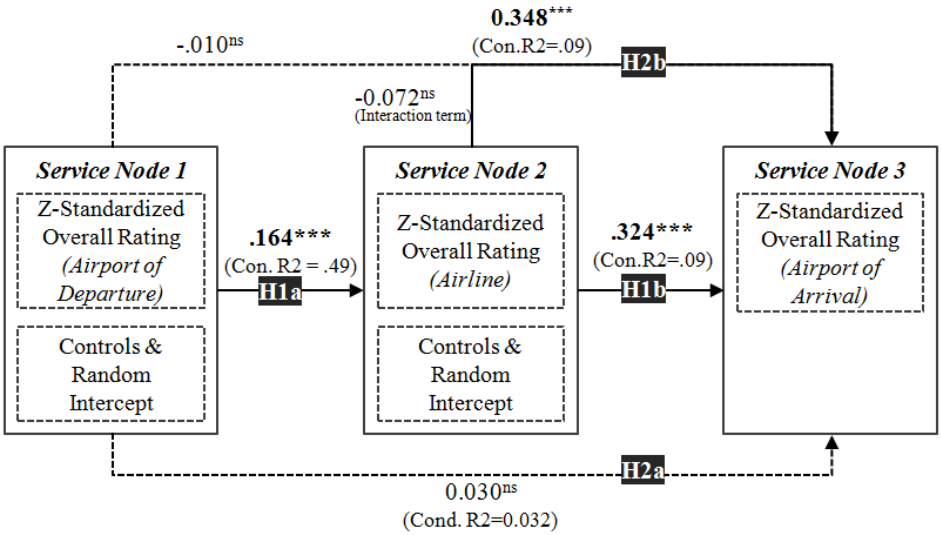
Our second research question is concerned with the question of how spillover effects in user-generated content evolve over multiple nodes of an interdependent service chain. We state two research hypotheses H2a and H2b to assess this question.

Model 3 that is concerned with H2a, which states that "increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3" shows that there is no evidence for cross-organizational spillover effects that affect more distantly arranged service nodes than directly connected service nodes in the interdependent service chain. Looking at our results in Table 4, we see that the coefficient of the z-standardized overall rating of the airport of departure (ap1_rating_z) of 0.030 is of no statistical significance and does therefore not affect the z-standardized overall rating of the airport of arrival (ap2_rating_z). While model 3 is not subject to multicolinerity issues with a VIF score of 1.044, the relative low conditional (marginal) R^2 of 0.032 (0.032) again shows that there is no evidence for spillover effects of more distantly arranged service nodes than directly connected ones. Therefore, we reject our research hypothesis H2a that "increased (decreased) overall ratings of service node 1 are associated with increased (decreased) overall ratings of service node 3".

In model 4, we put our research hypothesis H2b to test, which adds to research hypotheses H2a the possibility of a moderating effect of the overall rating of service node 2 on the spillover effect from service node 1 to service node 3. We reject this hypothesis as neither the z-standardized overall rating of the airport of departure (al_rating_z) nor the interaction term (ap1_rating_z*al_rating_z) is statistically significant. However, the z-standardized overall rating of the airline (al_rating_z) still has a statistically significant effect on the overall rating of the airport of arrival (ap2_rating_z) at the 1% level. This is in-line with with our finding in model 2. The conditional (marginal) R^2 of the model yields 0.094 (0.094) and indicates that we explain 9.4% of the overall variance. In addition, VIF scores show that the model has no multicollinearity issues.

The answer to our second research question is therefore that while spillover effects exist from service nodes on directly following service nodes in interdependent service chains, this is not true for more distantly arranged service nodes, i.e. service nodes that are not directly connected. Here, spillover effects appear to vanish. This is in-line with the implicit memory component of the TBA.

Drawing on the results of our four linear mixed effect models, we see that overall ratings of directly preceding service nodes exhibit spillover effects on their successor (i.e. service node 1 to 2 and service node 2 to 3). However, this is not true for service nodes which are more distantly arranged (i.e. service node 1 to 3). As a robustness check, we repeated our analysis in a multiple OLS regression setup without the random effect term and yield comparable results as within our linear mixed-effects approach. Figure 2 maps the results of our empirical study (see Table 4) to our proposed research model (see Figure 1).



* p<10%, ** p<5%, *** p<1. ns=not significant. Controls: price_lvl and days_pass variables.

Figure 3. Research Model Evaluation

4.3 Discussion

Our empirical findings suggest that spillover effects exist in online reviews of interdependent service chains: We show that increased overall ratings of a service node are associated with increased ratings of the directly following service node in an interdependent service chain and likewise that decreased overall ratings of a service node are associated with decreased overall ratings of the directly following service node. Furthermore, our results indicate that these spillover effects exhibit an implicit memory component as expected by the TBA, meaning that there is no evidence for spillover effects spanning over more distantly connected service nodes in interdependent service chains (e.g. from service node 1 to service node 3). We therefore provide evidence for cross-organizational spillover effects within user-generated online reviews of interdependent service chains. This is an important finding as this implies that the consumer perception of a service provider (e.g. an airline) is largely affected by up-stream service providers (e.g. the airport of departure).

We are aware that our study is setup confronted with several potential limitations that we will discuss in the following: First, it is likely that online service reviews concerning different services (e.g. airlines and airports) as well as different quality levels of services (e.g. cheap airline vs. premium airline) exhibit a different overall rating behaviour of reviewers. However, by z-standardization of each of the overall ratings of the airport of departure, airline and airport of arrival, i.e. by putting them into perspective to all other reviews of the same airline or airport ever posted on the analyzed platform, we rule out any potential biases arising from these differences. Second, reviewers might show differences in their baseline rating behaviour. For example, some reviewers may tend to provide overly positive or negative reviews. We account for this limitation by adding a random intercept for each individual reviewer to our mixed effect models. Third, reviewers could vary in the expectations of a service offered and therefore in their rating behaviour because of relative price levels of services. We account for this by adding a control variable for the price level of the used service to our mixed effect models. Furthermore, to account for time effects that were previously observed in studies, i.e. differences in the review behaviour because of overall shifts in the rating behaviour over time (e.g. inflationary positive reviews), we add a control variable for the age of the service review. Fourth, as our study covers services only, we agree that our study focuses on interdependent service chains and that in case of a physical product, online reviewers might react differently in terms of spillover effects as reviewers have more opportunities before and after the purchase to evaluate physical products. This could be a fruitful direction for future research on spillover effects in user-generated online reviews of interdependent service chains.

5 CONCLUSION

While multiple IS scholars show the importance of user-generated content in customer decision making processes and their direct impact on online retailers sales figures, little is known about drivers of the actual online review generation processes. We therefore examined the impact of cross-organizational spillover effects on online service review behaviour in the context of interdependent service chains. Spillover refers the extent to which "existing information and perceptions influence beliefs that are not directly addressed by or related to the original information source or perception object" (Janakiraman et al. (2009). We defined interdependent service chains as services that consist of more than one service node which are typically not used or usable without one-another but often operated by various providers.

We assessed two research question regarding spillover effects in interdependent service chains: First, do spillover effects exist in online reviews of interdependent service chains? Second, how do spillover effects evolve over multiple nodes of an interdependent service chain? Drawing on empirical insights we generate from online reviews of the interdependent service chain "non-stop one way flight" that consists of the three service nodes airport of departure, airline and airport of arrival, posted on the online review community www.AirlineQuality.com, we show that spillover effects are an important driver in the generation of online reviews. We find that both positive and negative spillover exists in online reviews of interdependent service chains, meaning that a good (bad) experience with an upstream service node in an interdependent service chain leads to more positive (negative) user-generated online reviews of the following service node in the service chain. Furthermore, we find no evidence of the persistence of spillover effects of a service node on more distantly following service nodes in interdependent service chains (e.g. from service node 1 on service node 3). Thus, our research extends the understanding of the impact of cross-organizational spillover effects on online reviews of interdependent service chain nodes and therefore extends the understanding of drivers of online review generation processes.

We contribute to the IS research stream of online reviews by providing evidence for the existence and insights into the evolvement of spillover effects in user-generated online reviews of interdependent service chains. We show that spillover effects can have both positive and negative consequences on user-generated online reviews of cross-organizational service chains. In addition, our work provides first evidence for the generalization of the GBA effect, the TBA. The TBA refers to the attribution of positive and negative characteristics to entities because of the entities they associate with and includes an implicit memory effect. Thus, TBA is capable to cope with both positive and negative spillover effects as well as a temporal dimension by the addition of the implicit memory.

Our results are especially important for practitioners as the perception of a company can be severely affected by associated companies that provide upstream services in interdependent service chain relationships. It is therefore important to actively measure or otherwise analyze the perception of upstream service providers. This could be operationalized by closely following online reviews of upstream service providers and making them aware of negatively perceived components of their services offered. Furthermore, it is possible that switching to more expensive but better perceived partner companies (i.e. companies with better online reviews) that provide upstream services in interdependent service chains could be in fact beneficial. This is because positive spillover effects of the upstream service provider could directly influence the perception and therefore the online reviews of a company. In turn, this could positively influence sales figures as it was shown in previous research that positive online reviews are associated with increased sales figures.

Future research could extend our work into multiple directions: First, spillover effects in interdependent product chains could be investigated to draw conclusions about context specific factors that might mitigate the spillover effects that we observed in our service oriented study. Second, in an extended version of our study, we plan to add numerous additional characteristics of the online service review.

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